DOCUMENT RESUME

ED 180 147 EC 121 846

AUTHOR	Becker, Laurence: Morrison, Gale
TITLE	The Effects of Levels of Organization on Clustering and Recall in Normal, Learning Disabled, and Educable Mentally Retarded Children. Final Report.
INSTITUTION	California Univ., Riverside.
SPONS AGENCY	Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
PUB DATE	Apr 78
GRANT	G007604709
NOTE	35p.
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Cognitive Processes: *Educable Mentally Handicapped: Exceptional Child Research: *Learning Disabilities: *Memory: Mentally Handicapped: *Recall (Psychological)

ABSTRACT

The cognitive input organization skill of clustering and its effect on recall were examined in 235 normal, learning disabled, and educable mentally retarded children within three mental age (MA) ranges (5 to 7 years, 7 to 9 years, and 9 to 11 years). Ss were assigned randomly to three conditions testing the effect of different levels of organization on recall and clustering. These conditions, in order of increasing organization, were random, blocked, and active sorting. Results for recall and clustering measures were parallel. All Ss increased their recall and clustering performance under the blocked and sort conditions, indicating that learning handicapped as well as nonhandicapped children are able to increase memory performance when given or encouraged to use an organizational strategy. The significant interaction found between MA and type of organization suggested that lower MA Ss needed assistance in the organization of materials, while higher MA Ss performed better when allowed to structure their own organization. (Author/DLS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

ED180147

EC

EC 121 946

THE EFFECTS OF LEVELS OF ORGANIZATION ON CLUSTERING AND RECALL IN NORMAL, LEARNING DISABLED, AND EDUCABLE MENTALLY RETARDED CHILDREN

Laurence Becker, Ph.D.
University of California, Riverside
Project Investigator

Gale Morrison
University of California, Riverside
Student Researcher

April, 1978

This document is submitted as the final report under U. S. Office of Education, Bureau of Education for the Handicapped Grant #G007604709

Abstract

The input organization skill of clustering and its effect on recall were examined in 57 normal, 87 LD, and 91 EMR children within 3 MA ranges: 5 to 7, 7 to 9, and 9 to 11. These subjects were assigned randomly to three conditions testing the effect of different levels of organization on recall and clustering. These conditions, in order of increasing organization were random, blocked, and active sorting. Results for recall and clustering measures were parallel. All children increased their recall and clustering performance under the blocked and sort conditions indicating that learning handicapped as well as nonhandicapped children are able to increase memory performance when given or encouraged to use an organizational strategy. The significant interaction between MA and type of organization suggested that lower MA subjects needed assistance in the organization of materials while higher MA subjects performed better when allowed to structure their own organization.

The Effects of Levels of Organization on Clustering and Recall in Normal, Learning Disabled, and Educable Mentally Retarded Children

Recent court cases and legislation for the rights of handicapped children have resulted in a trend to provide for the educational needs of these handicapped children in the least restrictive school environment. An immediate implication of this trend is that mildly handicapped children, specifically learning disabled (LD) and educable mentally retarded (EMR) children, will be spending part or all of the day in the regular classroom. Regular classroom teachers will have to learn to deal with an even wider range of learning abilities and styles than already exists in the regular classroom. Thus, it is imperative for these teachers to know as much as possible about the various learning characteristics of the children who will be in their classrooms.

A learning characteristic or ability that is crucial to school learning is memory. Short-term memory deficits have been noted in both EMR and LD students (Brown, 1974; Hallahan, 1975). Several authors have noted the central role that memory plays in cognitive functioning (Brown, 1975; Flavell, 1971; Hagen, 1975). Hagen (1975) suggested that "in some situations where a child appears to have a cognitive deficiency, the problem may lie more precisely in the child's memory processes" (p. 96).

In recent years research and theory development in memory processes has focused on the importance of the development of various strategies for committing information to memory (Flavell, 1970). It is hypothesized that a failure to use these strategies is responsible for the memory deficits

exhibited by young normal, learning disabled, and mentally retarded children. The present study focused on a memory strategy known as input organization. This strategy has been described by Parker, Freston, and Drew (1975) as "the ability to take mnemonic advantage of material that has been externally organized" (p. 54).

Review of the Literature

Overview of Input Organization

Recent studies on the development of memory have emphasized cognitive organization skills as central factors in the processing and recall of material. Memory is not a passive process, but one in which the learner "actively participates by transforming his perceptions of external reality into categorical hierarchies" (Parker et al., 1975, p. 53). These organizational skills are made necessary by the biological limitations of man's memory capacity. Man can process a limited amount of information at one time. Miller (1956) found this limit to be 7 ± 2 bits of information. One can increase the amount of information handled by combining bits of information into chunks. Miller (1956) called this process recoding and described it as a very powerful tool for increasing the amount of information with which humans can deal.

One of the strategies which facilitates recoding is clustering. Bousfield (1953) defined a cluster as "a sequence of associates having an essential relationship between its members" (p. 229). Thus, the strategy would be to cluster or categorize related material into groups to facilitate recall. Bousfield (1953) found that when given a randomly presented list of words from various categories, subjects recalled the words in their

categories more often than would be expected by chance. This clustering behavior was assumed to be a representation of a cognitive organizational behavior used for facilitation of recall. Indeed, later studies have shown a high positive correlation between clustering in recall and amount of recall (Moely & Jeffrey, 1974; Nelson, 1969; Rosner, 1971). Hence, as clustering increases so does recall, suggesting a possible relationship between the two. Mandler (1967) stated that memory and organization are not only correlated, but that organization is a necessary condition for memory. In a study involving subjective organization and rehearsal of unrelated words, Tulving (1966) found that rehearsal was effective in increasing recall only if it permitted the subject to organize the material into appropriate higher order memory units.

Theoretical Frameworks

Two theoretical frameworks are relevant to the study of input organization. The first was outlined by Spitz (1966), the other was proposed by Flavell (1970). Spitz viewed learning deficiency in the mentally retarded as a function of an inability to organize incoming information in a manner conducive to recall. Whereas normals acted on incoming information to aid in learning and memory, mentally retarded subjects did not. Spitz suggested that external organization of information may facilitate the recall of the mentally retarded by helping to compensate for their deficiency. Spitz used the measurement of clustering in free recall to examine this organizational behavior.

Flavell (1970) observed similar differences in cognitive organization skills between younger and older children. Flavell viewed input organization or clustering as a form of mnemonic mediation, which he defined as a

"cognitive act which could be deliberately undertaken for the purpose of storing and retrieving input" (Flavell, 1970, p. 193). Specific mediational strategies are adaptive for certain memory problems. The spontaneous utilization of the correct strategy is a positive function of age. Flavell theorized that as a child develops he becomes more "planful" in the use of strategies available to him. Applying this principle to clustering, a child's spontaneous use of clustering increases with age.

Flavell proposed that in younger children two types of deficiencies can occur. A mediational deficiency occurs when a mediator is produced at the appropriate time but is not used in an adaptive way to solve the task. A production deficiency appears when a child fails to generate a mediator spontaneously for use in a task situation. However, in the case of a child with a production deficiency, when he is given a mediator or prompted to use one, he is able to use it to facilitate performance. Keasey, Crawford, and Miser (1975) found that a child must have a category, either one he generates himself or one that is supplied to him, to organize material effectively for recall. Evidence cited by Flavell (1970) indicated that when given a mediator or instructed to use one, young children could use it appropriately and effectively. Thus, production deficiencies, not mediational deficiencies, were found in young children. These children did not produce mediators spontaneously as older children did. A young child may perform poorly on a recall task not because of poor memory skills, but because he failed to use organizational strategies to facilitate his memory. Production deficiencies also may be a problem for learning disabled and mentally retarded children. Like Spitz, Flavell suggested that the recall performance of the young children may be facilitated when

they are given effective mediational prompts.

Recall and Clustering in Normal Children as Effected by Age and Organization

Developmental studies on the organization of input for recall have demonstrated an age-related increase on measures of clustering and recall (Bjorklund, Ornstein, & Haig, 1977; Furth & Milgram, 1973; Kobasigawa & Middleton, 1972; Lang & Jackson, 1974; Mandler & Stephens, 1967; McCarver, 1972; Moely, Olson, Halwes, & Flavell, 1969; Moely & Shapiro, 1971; Neimark, Slotnick, & Ulrich, 1971; Rosner, 1971; Worden, 1975). Specifically, recall and clustering scores for kindergarten and first graders are significantly lower than for older children (Kobasigawa & Middleton, 1972; Moely et al., 1969). The next significant jump in recall and clustering scores takes place between the fourth and sixth grades (Moely et al., 1969; Moely & Shapiro, 1971; Neimark et al., 1971; Rosner, 1971; Worden, 1975). Neimark et al. (1971) noted that the development of organization strategies for free recall parallels the stages of cognitive development described by Piaget from preoperational to concrete to formal operations.

The significance of these age trends is clarified by examining them in relation to different levels of organization. The most common levels of organization used in item presentation have been random, blocked, and active sorting. In the random condition the words or pictures are presented in random order. In the blocked condition items are grouped into their respective categories. Active sorting allows the subject to manipulate the items into his own categorical arrangement. This sorting allows for the greatest amount of organization. The inclusion of active sorting is considered important because it gives the subject a chance to study the

items thoroughly and to use organization other than that provided by the experimenter (Lange & Jackson, 1974; Mandler & Stephens, 1967; Worden, 1975). In general, the blocked presentation increased subjects' recall and clustering over the random presentation (Cole, Frankel, & Sharp, 1971; Moely & Shapiro, 1971). Moely et al. (1969) used three levels of increasing organization, culminating with active sorting. Their data indicated a significant interaction between age and level of organization. Higher levels of organization were needed for younger subjects to show increases in recall and clustering. Older subjects increased their recall and clustering with less obvious organizational clues.

Mandler and Stephens (1967), Lange and Jackson (1974), and Worden (1975) examined the effect of sorting on the recall of items. They found that allowing the subjects to achieve stable sorting patterns minimized the differences in clustering and recall between age groups. Although Lange and Jackson (1974) found that the 1st grade subjects showed lower clustering scores than 7th or 6th grade subjects these scores were still higher than those exhibited for categories imposed by the experimenter.

Production Deficiencies in Normal Children

Production deficiencies appeared consistently in the studies reviewed. Flavell's production deficiency hypothesis is supported when it is demonstrated that subjects can categorize items on request or when prompted but fail to do so spontaneously. The results of the study by Moely et al. (1969) indicated that the younger subjects (kindergarten and first grade) did not sort or organize the items spontaneously; however, when instructed to sort, they could. Consequently, they were able to raise their recall and clustering scores significantly. Bjorklund et al. (1977), Furth and

Milgram (1973) and Moely et al. (1969) suggest that these younger children need more explicit organizational prompts than older children to show comparable increases in clustering and recall.

Recent studies by Tiche, Tighe, and Schechter (1975) and Tenney (1975) provide additional support for the production deficiency hypothesis in young children. "The children's utilization of the task categories did not appear to match their knowledge of them" (Tiche et al., 1975, p. 35). They found that the children could readily group into categories but did not use them to assist in the task.

Kobasigawa and Middleton (1972) and Kobasigawa and Orr (1973) indicated inefficiencies beyond a simple production deficiency in kindergarten and nursery school children. They found that even though kindergarten subjects could be induced to use categorical organization for recall, they had fewer items in the categories. Inefficiency in the use of categorization skills was also found in kindergarteners by Keasy et al. (1975). However, Bozinou and Goulet (1974) found that nursery school age children used conceptual cues to aid in free recall. Thus, there is some question as to how well very young children can perform on categorization tasks. However, evidence suggests that when children do possess categorization or classification abilities they do not use these skills spontaneously on the appropriate tasks.

Production deficiencies are evident, to a lesser extent, in children in the middle grades from second to fourth or fifth grade (Furth & Milgram, 1973; Kobasigawa & Middleton, 1972; Lange, 1973; Moely et al., 1969; Neimark et al., 1971; Rosner, 1971). These children are more likely to cluster spontaneously but still need some prompting to use this strategy in a recall

situation. By the fifth grade most children spontaneously organize their material for recall (Kobasigawa & Middleton, 1972; Moely et al., 1969; Rosner, 1971).

The findings of some studies have not been consistent with the results reported above. Nelson (1969) found that kindergarten children did not improve their recall performance on the blocked items. She suggested that the developmental change is not in the ability to organize but in the use of different strategies of organization. McCarver (1972) found that the older children were helped more by increasing organization of material than the younger children. His explanation for this discrepancy was that the increased organization did not involve enough active manipulation or participation to catch the attention of the younger children. In other words, the younger children did not notice the increase in organization. In studies by Lange (1973) and Shapiro and Moely (1971) developmental differences were not significant. Both studies cited their use of unrelated items as the possible cause of these results. The use of unrelated items makes it more difficult for the subject to discover possible categories. Hence, the task did not lend itself to the use of the strategy of categorization. Brown (1974) notes that developmental differences do not appear in memory tasks that do not demand strategic transformations for their efficient execution. Although some other strategy may have been used in this situation, the obvious one of categorization or clustering was not.

In general, the results of the studies on clustering in free recall with normal children have indicated a developmental increase in clustering and recall of material. A production deficiency was often evident in

younger children where the child had the strategy available to him but did not use it. Increasing the organization of material facilitated clustering and recall and enabled the young child to overcome the production deficiency.

Clustering and Recall in EMR Children

Spitz (1966) hypothesized that the short-term memory deficit exhibited by the mentally retarded was a function of their failure to organize input material spontaneously. Reichhart et al. (1975) described the behavior of mentally retarded subjects in memory tasks as "passive information processing," meaning that they make little effort to organize incoming stimuli. Results of early studies examining clustering and recall in categorical memory tasks were inconsistent. These studies used varying clustering measures and a wide range of ages and IQ's. One of the earlier studies by Osborn (1960) found no significant differences between brain-damaged and familial retarded subjects and equal MA nonretarded subjects on recall and clustering. However, Rossi (1963) found that normals recalled and clustered significantly more than equal MA retarded subjects. Rossi used a "corrected" clustering measure.

Using a clustering method developed by Bousfield (1953), Gerjuoy and Spitz (1966) studied the spontaneous clustering of a randomized list of nouns in mentally retarded and normal subjects of equal MA and CA. Significant clustering was found only in equal CA normals. The retarded subjects and their equal MA normal subjects recalled less and clustered less. Thus, mentally retarded subjects showed little spontaneous clustering and deficient recall. Recall was then studied under three conditions: presentation of a blocked list, requesting words from specific clusters upon recall, and a combination of the two. All three conditions, especially the combination

condition, increased clustering and recall in the retarded subjects. Thus, inducing clustering in the mentally retarded helped to raise their recall levels in memory tasks. This ability to use a strategy when provided, but not spontaneously, indicates a production deficiency in the retarded similar to that which occurs in young normal children.

Similar results were obtained by Simpson, King, and Drew (1970). They found that mentally retarded subjects improved their recall scores more than equal CA normals when a clustered rather than nonclustered list of words was presented. They concluded that the mentally retarded are deficient in their ability to impose organization on material. Gerjuoy, Winters, Pullen, and Spitz (1969) found that clustered material helped retarded subjects increase their clustering in recall which in turn facilitated their recall. Glidden (1977) also observed an increase in clustering and recall for retarded adolescents when material was presented in categories or when subjects were allowed to sort the categorical items.

Providing further evidence of a production deficiency, Wallace and Underwood (1964) and Spitz and Gerjuoy (cited in Spitz, 1966) used sorting tasks to learn whether retarded subjects were aware of the conceptual categories. In both studies the subjects were successful on the sorting task but did not transfer that conceptual knowledge to facilitate performance on a later recall task. Sperber, Ragain and McCauley (1976) confirmed that EMR children do not lack category knowledge but fail to use it in the recall process.

Gallagher (1969) found that mentally retarded subjects recalled fewer words than equal CA normals but that their subjective organization was no different. He concluded that the deficiency was in short-term memory.

However, as in several studies with normals cited earlier, the lists used consisted of unrelated words. Since the words were not readily organized, the subjects may have resorted to pure recall.

Evidence indicates that the mentally retarded do not learn to utilize clustering strategies spontaneously in recall tasks. They seem to stay at the stage of development of a young normal child. However, if provided with a clustering prompt, they can take advantage of it to facilitate their recall performance. Riegal (1972) developed a training program including the development of sorting skills. The program was effective in improving the performance of mildly retarded children on grouping and recall skills.

Clustering and Recall in Learning Disabled Children

Few studies have examined the effect of categorical organization on the recall performance of learning disabled children. Spitz (1966) cited some observations made by R. J. Capobianco of "brain-injured normals" attending a special school. Instead of using conceptually related categories, Capobianco studied grouped and ungrouped digits. He found that the brain-injured students recalled significantly fewer digits in the ungrouped condition than in the grouped condition. However, when given experience with grouped digits, the subjects were able to apply those skills to ungrouped digits. Again, what appears is a production deficiency, an inability to organize material spontaneously. A production deficiency was also exhibited by learning disabled children in a study by Ring (1976). Although the performance of LD children was significantly lower than a normal comparison group, the LD children were able to take advantage of the groupings of words to increase their recall.

Freston and Drew (1974) studied the recall performance of learning

disabled children as a function of organization and difficulty of recall material. Organization consisted of blocked versus randomly arranged lists of conceptually related words. Although subjects performed differently as a function of difficulty, there were no changes due to organization. This finding is in conflict with studies involving normal and mentally retarded subjects where organization had significant effects on performance. Parker, Freston, and Drew (1975) did a follow-up study involving the same tasks but including a normal comparison group. In this study the normal subjects increased recall performance with organization (blocked lists). However, the learning disabled subjects did not improve their recall performance on the blocked list of words. The finding that an organizational prompt did not facilitate the performance of the learning disabled subjects indicates a mediational deficiency. Even with a mediational device (categorized lists) available to them, they could not use it to facilitate task performance.

Riegel, Taylor, and Danner (1973) trained potentially learning disabled students in sorting strategies. Their findings indicated that young potentially learning disabled children can be trained to organize information systematically. Clustering scores increased, but recall scores did not. Again, the children did not take advantage of mnemonic organization available to them. In general, the few studies done with LD children indicate that they may have a mediational deficiency.

The present study examined several aspects of input organization in need of clarification. Comparisons were made between LD, EMR and normal children on recall and clustering measures. Research findings emphasize the importance of couching these comparisons in a developmental framework; therefore, the mental age ranges of 5 to 7, 7 to 9 and 9 to 11 were studied for each

group. Previous findings also indicate that varying levels of organization have different effects on recall and clustering performances. Therefore, the present investigation studied the effects of different levels of input organization on 3 developmental levels of normal, LD and EMR children.

Method

Subjects

Subjects for this study included 57 normal, 87 LD, and 91 EMR boys from six southern California school districts. These subjects were distributed across the mental age ranges of 5-7, 7-9 and 9-11. Mental age was measured by the Quick Test, an individual intelligence test that takes approximately 10 minutes to administer (Ammons & Ammons, 1962). The test is based on perceptual-verbal performance and requires no reading, speaking or writing by the examinee (a signal of yes or no is required in response to questions about pictures).

The EMR subjects were chosen from the EMR classes of the districts sampled. EMR classes ideally (see comments in the paragraph below) consist of students who have encountered extreme academic problems, have subaverage intelligence (approximately 55-70), and have an impairment of adaptive behavior. In order to get EMR subjects with MA's in the 3 ranges, it was necessary to include junior high and high school EMR students. Because of the scarcity of EMR subjects, every student of the appropriate MA that had parent permission was included in the study. The number of EMR subjects found within the 3 MA ranges determined the number of LD and normal subjects sought in the respective MA range. Although EMR subjects were typically located in classes at one school in the district, LD and normal subjects were sampled additionally from the other schools. An equal number of LD

and normal subjects were chosen from each school as they qualified for one of the 3 MA ranges.

The learning disabled subjects were chosen from learning disability group (LDG) classes. In California a learning disabled child is defined as one who is normally intelligent but at least two years behind in expected academic achievement. Since LDG students commonly are identified and placed after age 7 or 8, the younger LD subjects were those students identified by their regular class teacher as normally intelligent but having problems with academic achievement.

The normal subjects were chosen from a sample of students attending regular classes (kindergarten through fifth grade). These subjects were rated as "normal" by their teachers (i.e., not identified as being gifted or in need of remedial help).

Time factors (end of school year) caused the discrepancy in number of subjects between the three groups. Table I includes the mean CA's, MA's and IQ's for each group.

Although the definitions of EMR and LDG groups 'appear" clear and distinct, recent events in California necessitate caution in generalizing beyond California LDG and EMR children. Recent lawsuits charging discriminatory evaluation and placement in EMR classes have resulted in reluctance to place children, especially minority children, in EMR classes and in increased placement in the learning disability settings (Educationally Handicapped (EH) and Learning Disability Group (LDG) classes). Thus, definitions and regulations provide guidelines within which schools operate, but distinctions between groups have become clouded due to variations in school policy and realities of school situations.

Materials

Materials consisted of black and white drawings taken from the Peabody Picture Vocabulary Test. Four categories were used: food, animals, clothing and vehicles. Each category contained 4, 5, or 6 pictures.

	4	5	6
Food:	grapes, banana, cake, apple	hot dog	cone
Animals:	cat, cow, dog, horse	chicken	elephant
Clothing:	belt, sock, tie, shoe	dress	jacket
Vehicles:	train, boat, car, bike	bus	truck

The 4, 5, or 6 picture categories were given to MA levels 5-7, 7-9, and 9-11 respectively. BEH officials requested this differentiation. The pictures were mounted on a board or presented loose according to the task condition.

Procedure

Subjects were randomly assigned to one of three experimental conditions (random, blocked, and active sorting). Numbers of S's in each condition by type and MA is summarized in Table II.

In the random condition, pictures mounted on a piece of cardboard were presented to the S. Pictures were arranged in four rows with four, five, or six pictures in each row. Pictures were arranged randomly with no picture appearing adjacent to another picture from the same category. E pointed to the pictures one by one and asked S to name each one. E corrected S where necessary. E then gave the following instructions:

> Now we are going to play a picture remembering game. You sit here and study these pictures. In a few minutes I will cover them up and ask you to name the pictures that you saw. OK. Go ahead and study the pictures.

E gave S exactly two minutes to study the pictures. E then covered the pictures and asked S to name the pictures he saw.

In the blocked condition, pictures were mounted on cardboard in their respective categories with one category in each of the four rows. E pointed to each picture asking S to name each one. E then said, "Notice that each row has the same kinds of pictures in it. These pictures are kinds of food, these are animals" . . . and so forth for each row of pictures. E then proceeded with the instructions given for the random condition.

Upon completion of the tasks for both the random and the blocked condition, E presented S with the same pictures cut separate from the cardboard and asked him to sort the pictures into "groups of pictures that go together." E then suggested to S that in the future he could use these categories as an easy way to remember a list of words or pictures. The purpose of this task was to get measures of categorical sorting abilities for these subjects. Categories formed, names of categories given and pictures in each category were recorded.

In the sorting condition, E placed the pictures randomly in front of the subject. E asked S to name each picture as he placed it on the table. E then said, "Sort these pictures into groups of pictures that go together or are alike." When S indicated that he was finished, E asked S to give a name to each group he formed. E gave the following instructions:

> Now we are going to play a picture remembering game. You sit here and study these pictures and in a few minutes I will cover them up and ask you to name the pictures that you saw. It might be helpful for you to remember the pictures in each

group together. OK. Go ahead and study the pictures.

E gave S two minutes to study the pictures. At the end of this time E covered the pictures and asked the S to name the pictures he saw. During the task E recorded the categories formed, names given for the categories and pictures in each category.

Measures

The number, order, and names of pictures recalled in each condition by each subject was recorded. Percentage recall score for each subject was calculated. The measure of clustering in recall used was the Item Clustering Index (ICI) developed by Robinson (1966). The ICI is defined as $r/c\ (W_c-1)$, where r = the number of category pairs occurring continuously in recall, c = the number of categories represented in the recall, and W_c = the number of items per category in the stimulus list.

Results

Since the correlation between the dependent measures of clustering and recall was .915 and the results for both measures were parallel, only the results for clustering will be reported here. The data were subjected to a 3 X 3 X 3 (classification X MA X treatment) analysis of variance and a least-squares solution was obtained (Winer, 1971, p. 404). The clustering scores of the EMR, LD, and normal groups were not significantly different ($F = .23$, $df = 2/207$, $p > .05$). However, there was a significant interaction between treatment and mental age ($F = 3.6$, $df = 4/207$, $p < .01$).

In order to clarify the nature of the interaction, the EMR, LD, and normal groups were combined and three one-way ANOVA's were performed for the three treatment conditions stratifying by MA and three one-way ANOVA's

were performed for the three MA levels stratifying by treatment (see Table III for mean clustering scores).

Of the three ANOVA's on treatments stratified by age, only the one for the blocked condition was significant ($F = 4.78$, $df = 2/63$, $p < .025$). Tukey's test for the case of unequal n's (Kramer, 1956) was used to make pairwise comparisons. In the blocked condition, the MA 5-7 and MA 7-9 groups scored higher than the MA 9-11 group ($p < .05$).

When stratified by treatment for the three MA levels, differences appeared at all three age levels between the treatment conditions (MA 5-7--$F = 19.26$, $df = 2/53$, $p < .001$; MA 7-9--$F = 46.9$, $df = 2/76$, $p < .001$; MA 9-11--$F = 68.53$, $df = 2/96$, $p < .001$). Clustering scores in the random condition for all three MA levels were significantly less than in the blocked and sort conditions ($p < .05$). In addition, clustering scores for the MA 5-7 group were significantly less in the sort condition than in the blocked condition ($p < .05$). The opposite finding resulted for the MA 9-11 group; scores for the blocked condition were lower than those for the sort condition ($p < .05$).

Discussion

The major finding of this study was that material organization (as in the blocked and sort conditions) facilitates clustering and recall for LD, EMR, and normal children of mental ages from 5 to 11. The improvement exhibited by all groups when pictures were organized in comparison to when no organization was provided confirms the existence of production deficiencies in these children. Although they did not organize material spontaneously, normal, LD, and EMR children were all able to take advantage of

organization provided to facilitate their recall. In other words, the memory performance of these children can be improved by providing them with organized input or encouraging them to organize input themselves. This finding has implications for classroom practices which will be discussed later.

No differences were found between the three groups LD, EMR, and normal indicating that the type of memory strategy (categorization) used in this study may function similarly in mentally retarded, learning disabled, and normal populations; the difference being that LD and EMR children are functioning like older chronoligical age normal children. The similarity in functioning of equal MA retarded and normal children was predicted by Zigler (1969) in his developmental hypothesis. It appears that the memory strategy may develop in the same way, only slower in mentally retarded children.

Developmental differences were found in only one treatment condition (blocked) for the three groups. The reverse nature of these differences (MA 5-7 and MA 7-9 performed at the highest level; MA 9-11 at the lowest level) is difficult to explain. It may be the case that adult imposed organization helps lower MA children but hinders the higher MA children. Although none of the three groups showed an increase in spontaneous organization (as in the random condition), such an increase has been well documented for normal children in other developmental memory studies (Bjorklund et al., 1977; Furth & Milgram, 1973; Kobasigawa & Middleton, 1972; Moely et al., 1969). Evidence for a similar developmental increase in recall and clustering in LD and EMR children is not available and is

not indicated by this study.

At first glance the lack of age differences across treatments is surprising in view of the consistent findings of these differences in the research literature. However, at the request of BEH, the investigator varied the number of pictures given to the three age groups (more pictures per category were given to the older children). Because the dependent measures (percentage recall and the ICI clustering index) include a correction for how many pictures there are in each category, it is likely that developmental differences were obscured by the increase in number of pictures per category for each age level group.

The results of this study indicate that even the youngest group (5-7 years old) could take advantage of material organization to facilitate recall suggesting that they have the categorization skills but do not utilize them. These findings confirm those of Moynahan (1973) and resolve the doubts of Kobasigawa and Middleton (1972) and Nelson (1969) as to the capabilities of this youngest group.

The treatment X age interaction adds an interesting complexity to the development of the memory strategy of input organization. Although both the blocked and sort conditions facilitated clustering and recall, this facilitation was different for the youngest and oldest group. While recall and clustering performance in the sort condition was superior for the oldest group, performance was best in the blocked condition for the youngest group. These findings are similar to those of Tenney (1975) who found the same facilitation of a self-directed organization for sixth graders and failure of that organization for kindergarten children. The sorting condition or the self-directed method requires that the child actively engage in a cate-

gorization process. It is likely that young children, although capable of recognizing and using categorization skills, are not adept enough at the process to generate their own categories and then apply them to the memory process. In contrast, the older children function optimally when allowed to generate their own organization--the strategy has been incorporated into their natural repertoire of memory strategies. Thus, there seems to be an ideal match between type of organization available and developmental level for optimal clustering and recall. A similar "goodness of fit" between task structure and subjects preference for organizational strategy was found by MacMillan (1972) with EMR and normal subjects on a digit memory task.

The results of this study have important implications for the education of mildly handicapped and nonhandicapped children. It has been demonstrated that input organization significantly increases clustering and recall. Given the common memory deficits exhibited by EMR, LD and young normal children, an effective way of increasing memory would be to present materials to be learned in an organized manner or instruct the children to organize the materials for themselves. Such arrangements could be incorporated into every facet of the curriculum to increase the probability of optimal learning. In support of the incorporation of organized material and teaching of organization skills into curricular arrangement is the recent call for teaching processes of learning rather than products of learning (Ryan, 1971). Taba (1967) has developed a sequence of activities with the goal of teaching thinking. Organization and categorization skills are an important basis for the development of higher level thinking skills. In addition to developing thinking skills, organization and categorization have been shown in this

study to improve the memory abilities that are so crucial to school learning.

The findings of this study also suggest that certain organizational strategies may be more effective at some mental ages than others. Younger children may need more explicit instructions or assistance in the organization of material for recall. As the mental ages of the children increase, they may be better able to organize material on their own. Thus, it would be important for a teacher to diagnose the level of memory strategy functioning of his/her students and design prompts or instructions according to their effectiveness with the particular levels of functioning of the students.

Although normal children naturally develop the spontaneous use of organizational strategies, LD and EMR children may need assistance with this development. Additional research is needed to determine whether these children can be taught to use organizational memory strategies in a purposeful way. Further, if these strategies can be taught, how well do they generalize and transfer to other situations. The importance of the ability to organize materials for learning is emphasized in a study by Bilsky and Evans (1970). They found a high correlation between ability to organize incoming verbal material and performance on reading comprehension tasks. They suggest that the educational performance of retarded students in reading comprehension might be facilitated by remediating deficiencies in input organization.

The importance of the active use of the strategy of input organization is reflected in recent theorizing about the development of memory in general. Increasingly, the development of memory has been associated with the develop-

ment of the efficient and active use of memory strategies such as rehearsal, elaboration and organization (Brown, 1974; Buckhalt, Mahoney, & Paris, 1976). Soviet investigators are concerned with the active and purposeful nature of efficient memory (Meacham, 1977). Brown (1975) emphasizes the development of a conscious and purposeful orientation to memory tasks (called metamemory). The goal of future research should be to further describe how these memory processes operate in handicapped and nonhandicapped children and to indicate what we as educators can do to facilitate these processes.

References

Ammons, R. B., & Ammons, C. H. The Quick Test (QT): Provisional Manual. Psychological Reports, 1962, 11, 111-161, Monograph supplement I-VII.

Bilsky, L. H., & Evans, R. A. Use of associative clustering technique in the study of reading disability: Effects of list organization. American Journal of Mental Deficiency, 1970, 74, 771-776.

Bjorklund, D. F., Ornstein, P. A., & Haig, J. R. Developmental differences in organization and recall: Training in the use of organizational techniques. Developmental Psychology, 1977, 13, 175-183.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bozinou, G., & Goulet, L. R. Acquisition and transfer of sorting mechanisms in discrimination learning and free recall by nursery school children. Child Development, 1974, 45, 816-820.

Brown, A. L. The role of strategic behavior in retardate memory. In N. R. Ellis (Ed.), International Review of Research in Mental Retardation, Vol. 7. Academic Press, 1974.

Brown, A. L. The development of memory: Knowing, knowing about knowing and knowing how to know. In H. W. Reese (Ed.), Advances in Child Development and Behavior, Vol. 10. New York: Academic Press, 1975, pp. 103-152.

Buckhalt, J. A., Mahoney, G. J., & Paris, S. G. Efficiency of self-generated elaborations by EMR and nonretarded children. American Journal of Mental Deficiency, 1976, 81, 93.

Cole, M., Frankel, F., & Sharp, D. Development of free recall learning in children. Developmental Psychology, 1971, 4, 109-123.

Flavell, J. H. What is memory development the development of? Human Development, 1971, 14, 227-286.

Flavell, J. H. Developmental studies of mediated memory. In H. W. Reese and L. P. Lipsitt (Eds.), Advances in Child Development and Behavior, Vol. 5. New York: Academic Press, 1970.

Freston, L. W., & Drew, C. J. Verbal performance of learning disabled children as a function of input organization. Journal of Learning Disabilities, 1974, 7, 34-38.

Furth, H. G., & Milgram, N. A. Labeling and grouping effects in the recall of pictures by children. Child Development, 1973, 44, 511-518.

Gallagher, J. A comparison of retarded and normals on subjective organization in short term memory. American Journal of Mental Deficiency, 1969, 73, 661-665.

Gerjuoy, I. R., & Spitz, H. H. Associative clustering in free recall: Intellectual and developmental variables. American Journal of Mental Deficiency, 1966, 70, 918-927.

Gerjuoy, I. R., Winters, J. J., Pullen, M. M., & Spitz, H. H. Subjective organization by retardates and normals during free recall of visual stimuli. American Journal of Mental Deficiency, 1969, 73, 791-797.

Glidden, L. M. Stimulus relations, blocking and sorting in the free recall and organization of EMR adolescents. American Journal of Mental Deficiency, 1977, 82, 250-258.

Hagen, J. W., Jongeward, R. H., & Kail, R. V. Cognitive perspectives on the development of memory. In H. W. Reese (Ed.), Advances in Child Development and Behavior, Vol. 10. New York: Academic Press, 1975.

Hallahan, D. Comparative research studies on the psychological characteris-

tics of learning disabled children. In Cruickshank and D. Hallahan (Eds.), Perceptual and Learning Disabilities in Children, Vol. 2. New York: Syracuse University Press, 1975, 29-62.

Keasey, C. T., Crawford, D. G., & Miser, A. L. Classification: An organizing operation for memory. Developmental Psychology, 1975, 11, 409-410.

Kobasigawa, A., & Middleton, D. B. Free recall of categorized items by children at 3 grade levels. Child Development, 1972, 43, 1967-1072.

Kobasigawa, A., & Orr, R. R. Free recall and retrieval speed of categorized items by kindergarten children. Journal of Experimental Child Psychology, 1973, 15, 187-192.

Kramer, C. Y. Extension of multiple range tests to group means with unequal numbers of replications. Biometrics, 1956, 12, 307-310.

Lange, G. The development of conceptual and rate recall skills among school age children. Journal of Experimental Child Psychology, 1973, 15, 394-406.

MacMillan, D. L. Facilitative effect of input organization as a function of verbal response to stimuli in EMR and nonretarded children. American Journal of Mental Deficiency, 1972, 76, 408-411.

Mandler, G. Organization and memory. In K. W. Spence and J. T. Spence (Eds.), The Psychology of Learning and Motivations, Vol. 1. New York: Academic Press, 1967.

McCarver, R. B. A developmental study of the effect of organizational cues on short-term memory. Child Development, 1972, 43, 1317-1325.

Meacham, J. A. Soviet investigations of memory development. In R. V. Kail, Jr., and J. W. Hagen (Eds.), Perspectives in the Development of Memory and Cognition. Hillsdale, New Jersey: Laurence Erlbaum Associates, 1977.

Miller, G. A. The magical number seven plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 2, 81-97.

Moely, B. E., & Jeffrey, W. E. The effect of organization training on children's free recall of category items. Child Development, 1974, 45, 135-143.

Moely, B. E., Olson, F. A., Halwes, T. J., & Flavell, J. H. Production deficiency in young children's clustered recall. Developmental Psychology, 1969, 1, 26-34.

Moynahan, E. D. The development of knowledge concerning the effect of categorization upon free recall. Child Development, 1973, 44, 238-246.

Neimark, E., Slotnick, N. S., & Ulrich, T. Development of memorization strategies. Developmental Psychology, 1971, 5, 427-432.

Nelson, K. J. The organization of free recall by young children. Journal of Experimental Child Psychology, 1969, 8, 284-295.

Osborn, W. J. Associative clustering in organic and familial retardates. American Journal of Mental Deficiency, 1960, 65, 351-357.

Parker, T. B., Freston, C. W., & Drew, C. J. Comparison of verbal performance of normal and learning disabled children as a function of input organization. Journal of Learning Disabilities, 1975, 6, 53-60.

Reichhart, G. J., Cody, W. J., & Borkowski, J. G. Training and transfer of clustering and cumulative rehearsal strategies in retarded individuals. American Journal of Mental Deficiency, 1975, 79, 648-658.

Riegel, R. H., Danner, R. W., & Taylor, A. M. Steps in sequence: Training educationally handicapped children to use strategies for learning. Development Report No. 2. Minneapolis: Research, Development and

Demonstration Center in Education of Handicapped Children, University of Minnesota, 1972. (Mimeo.)

Riegal, R. H., Taylor, A. M., & Danner. F. W. Teaching potentially educationally handicapped children to classify and remember. Exceptional Children, 1973, 40, 208-209.

Ring, B. C. Effects of input organization on auditory short term memory. Journal of Learning Disabilities, 1976, 9, 59-63.

Robinson, J. A. Category clustering in free recall. Journal of Psychology, 1966, 62, 279-285.

Rossi, E. L. Associative clustering in normal and retarded children. American Journal of Mental Deficiency, 1963, 67, 691-699.

Rosner, S. R. The effects of rehearsal and chunking instructions on children's multi-trial free recall. Journal of Experimental Child Psychology, 1971, 11, 93-105.

Ryan, F. L. Exemplars for the social studies. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.

Shapiro, S. I., & Moely, B. E. Free recall, subjective organization, and learning to learn at three age levels. Psychonomic Science, 1971, 23, 189-191.

Simpson, R. L., King, J. D., & Drew, C. J. Free recall by retarded and non-retarded subjects as a function of input organization. Psychonomic Science, 1970, 19, 334.

Sperber, R. D., Ragain, R. D., & McCauley, C. Reassment of category knowledge in retarded individuals. American Journal of Mental Deficiency, 1977, 81, 227-234.

Spitz, H. H. The role of input organization in the learning and memory of mental retardates. In N. R. Ellis (Ed.), International Review of Research in Mental Retardation, 1966, Vol. 2, 29-56.

Taba, H. Teacher's Handbook for Elementary Social Studies. Palo Alto, California: Addison-Wesley Publishing Co., 1967.

Tenney, U. J. The child's conception of organization and recall. Journal of Experimental Child Psychology, 1975, 19, 100-114.

Tighe, T., Tighe, L. S. & Schechter, A. J. Memory for instances and categories in children and adults. Journal of Experimental Child Psychology, 1975, 20, 22-37.

Tulving, E. Subjective organization and effects of repetition in multi-trial free-recall learning. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 193-197.

Wallace, W. P., & Underwood, B. J. Implicit response and the role of intra-list similarity in verbal learning by normal and retarded subjects. Journal of Educational Psychology, 1964, 55, 362-370.

Winer, B. J. Statistical Principles in Experimental Design. New York: McGraw-Hill, 1971.

Worden, P. E. Effects of sorting on subsequent recall of unrelated items: A developmental study. Child Development, 1975, 46, 687-695.

Zigler, E. Developmental versus difference theories of mental retardation and the problem of motivation. American Journal of Mental Deficiency, 1969, 72, 536-556.

TABLE I

Chronological Ages (CA's), Mental Ages (MA's)

and IQ's of Subjects

	CA		MA		IQ	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Normal	8.36	18.08	8.45	16.39	102.68	17.32
LD	9.54	17.33	8.31	16.67	88.14	16.34
EMR	13.36	26.51	7.79	15.02	59.40	11.48

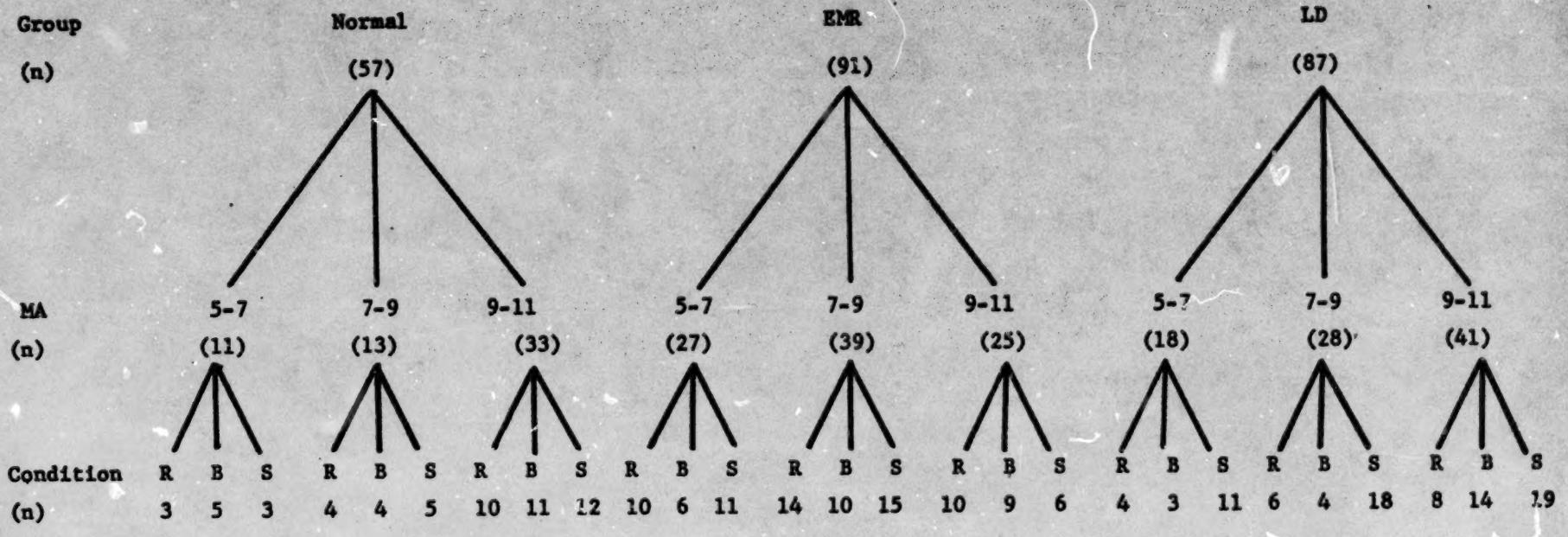
TABLE III

Mean Clustering Scores for All Subjects at

Three MA Levels in the Three Experimental Conditions

	Treatment		
MA	Random	Blocked	Sort
5-7	.11	.64	.46
7-9	.11	.58	.57
9-11	.16	.46	.59

TABLE II



R = Random

B = Blocked

S = Sort